**Comparison of Nonpoint and Point Sources of Nutrients with Instream Transport for Selected Watersheds of the Lower Tennessee River Basin, 1992**

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**INTRODUCTION**

The plant nutrients nitrogen and phosphorus are present in surface waters and are essential to aquatic life, but high concentrations of these nutrients impair use of surface-water resources. Excessive growth of aquatic plants in water bodies causes depletion of oxygen, adverse effects on other aquatic life, increased cost of water treatment, and loss of recreational value. Nutrient con­tamination is listed as a cause of impairment in one-third of the 15,000 impaired river miles in Tennessee, and in nearly one-half of the 121,000 impaired lake acres (Tennessee Department of Environment and Conservation, 1996). A recent study of nutrient contamination in surface waters, which focused on long-term monitoring data from more than 300 rivers and lakes across the United States, reported that nutrient concentrations in surface waters generally are related to land use in the upstream watershed: the highest nutrient concentrations occurred downstream from agricultural and urban areas (Mueller and Helsel, 1996). As part of an ongoing investigation of the lower Tennessee River Basin by the U.S. Geological Survey’s National Water Quality Assessment program, this same approach was applied to historic nutrient data from the basin to compare instream transport with watershed sources. The purposes of this paper are to describe the spatial variation in instream transport of nutrients in the lower Tennessee River Basin, to describe the spatial variation in the major sources of nutrients in the basin, and to relate spatial variation in transport with variation in sources and land use.

**APPROACH**

Historic data for streamflow and instream nitrogen and phosphorus concentrations at 16 long- term monitoring sites in the basin were summarized as annual estimates of nutrient instream load, also referred to as nutrient export (John A. Robinson, U.S. Geological Survey, written commun., 1998). For comparison with these estimates of export, quantitative estimates of land use, land cover, and various watershed sources of nitrogen and phosphorus were compiled or computed for the watersheds contributing to 11 of these sites. The sources estimated for this analysis included anthropogenic sources (wastewater discharge, fertilizer application, and livestock production) and atmospheric deposition; natural sources and other anthropogenic sources could not be quantified. Data from 1992 were used for comparison where possible, because more data were available in the data sets for instream concentration, nutrient sources, and land use for this period, and because use of a common period provides for better spatial comparisons among sites. To further facilitate spatial comparisons, estimates of sources and export were converted to unit-area loads.

**RESULTS AND DISCUSSION**

Unit-area export of nitrogen in 1992 at the 11 sites ranged from 1.0 to 3.5 tons per square mile. Estimates of nitrogen contributed as wastewater ranged from 0 to 0.61 tons per square mile. The ratio of nitrogen wastewater input to total nitrogen export for a watershed was as high as 0.26:1, but the correlation between wastewater input and export for the set of all sites was low (correla­tion coefficient, r, was 0.2), indicating either significant instream processing of wastewater, or larger contributions from other sources, at most sites. Input/export ratios for the other estimated sources (atmospheric deposition, fertilizer application, and livestock waste) were for the most part much larger than 1:1; however this ratio has less physical significance for these latter sources because the estimated input is the mass deposited or applied to the land surface, rather than mass discharged directly to the water body. The correlation between input and export for the set of all sites is of more interest than the at-site ratios of input to export for these sources. Of the three sources, livestock waste showed the highest correlation to export (r = 0.6). The strong correlation between the percentage pasture land cover within the watershed and nitrogen export (r = 0.7) may be a related result. Correlations of nitrogen export with the percentage of other land use/land cover types were much lower, r = 0.1 and 0.2 for the percentage cultivated and percentage urban land, respectively.

Unit-area export of phosphorus ranged from .03 to 1.14 tons per square mile in 1992. The ratio of phosphorus wastewater input to total phosphorus export was even higher (as high as 1.3:1) than the ratio for nitrogen at most sites, but correlation of input to export was low (r = -0.2). Correla­tion between input and export was low for the other quantified sources as well, indicating that other factor(s) control instream transport of phosphorus in these watersheds. The influence of a known natural source, phosphate-rich limestone in the lower Duck and Elk River Basins, was examined by excluding sites in these areas from the correlation data set. These sites had the high­est phosphorus export, but were not among the highest for any of the estimated inputs. The very strong correlations of phosphorus export with wastewater and with fertilizer application for this reduced data set (r > 0.9 for both sources) support two related conclusions: (1) one or both of these sources control instream transport of phosphorus in watersheds where the natural phospho­rus source is not present, and (2) the natural source is the largest contributor to instream transport of phosphorus in watersheds where it is present (the lower Duck and Elk River Basins).

**REFERENCES**

Mueller, D.K., and Helsel, D.R., 1996, Nutrients in the nation’s waters--too much of a good thing?: U.S. Geological Survey Circular 1136, 24 p.

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